8520A

Digital Multimeter

Quick Reference Guide

FLUKE

INTRODUCTION

The 8520A Quick Reference Guide is designed to provide the operator with an easy-to-use overview of the 8520A Digital Multimeter's operational features. The Guide can be used in such a way that both experienced and non-experienced operators alike can learn and use the 8520A's full capabilities.

This quick reference is divided into the following sections:

1) Front Panel Operation Page 2
2) Math Programs and Examples Page 6
3) Burst operation and correlation chart Page 19
4) IEEE-488 System Programming Page 22

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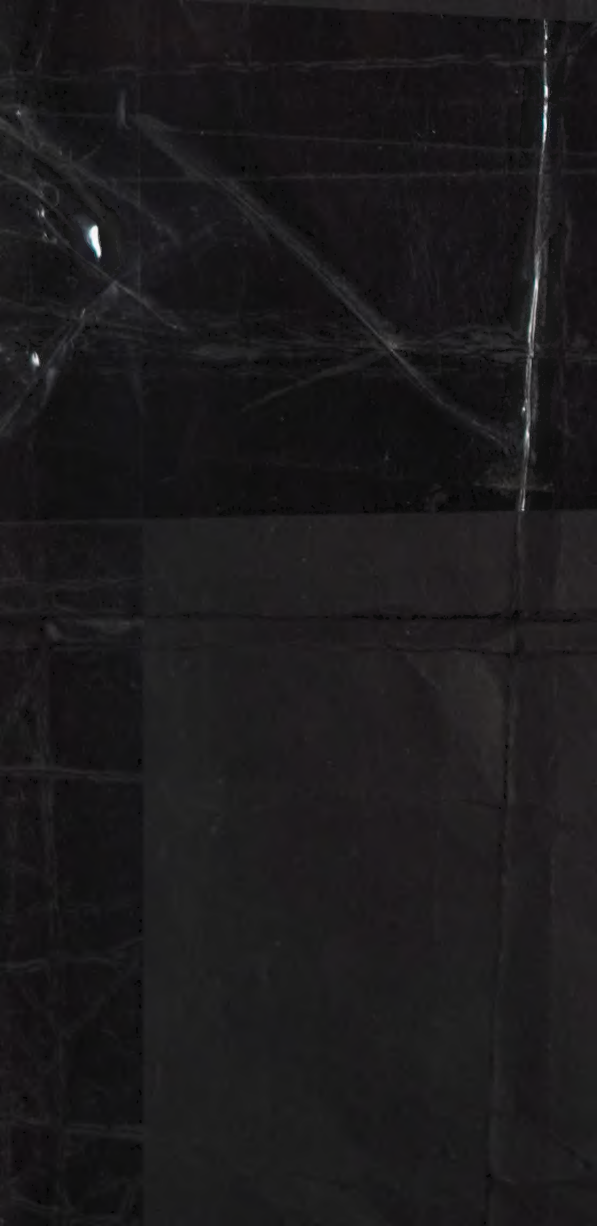
FRONT PANEL CONTROLS		
Group	**Name**	**Function**
Power	On/Off	Controls application of line power.
Function	VDC	Selects volts DC mode.
	VAC	Selects volts AC mode.
	VDC + VAC	Selects volts AC + DC for combined measurements by depressing both keys simultaneously.
	Ω 2 Wire	Selects 2 wire ohm measurement.
	Ω 4 Wire	Selects 4 wire ohm measurement.
	nS	Selects conductance measurement on fixed nS range.
NOTE:		Selecting any of the above functions causes the 8520A to default to the auto range mode, a reading rate of 2 r/s and the 500 msec filter settling time (with the exception of nanosiemens which has a fixed range).
Range	Auto	Toggle Action— LED ON: Autorange active on all functions (except nS) when LED on. Fixed range when LED off.
	△ ▽	LED OFF: Manual ranging mode steps up/down next higher/lower range takes 8520A out of Auto. Has no effect at top/bottom of range.
Reading Rate	△ ▽	Increases/decreases one step in reading rate per depression, automatically selecting optimum filter settling time. No effect at top/bottom of range.
Filter	△ ▽	Increases/decreases filter settling time one step per depression. No effect at top/bottom range.

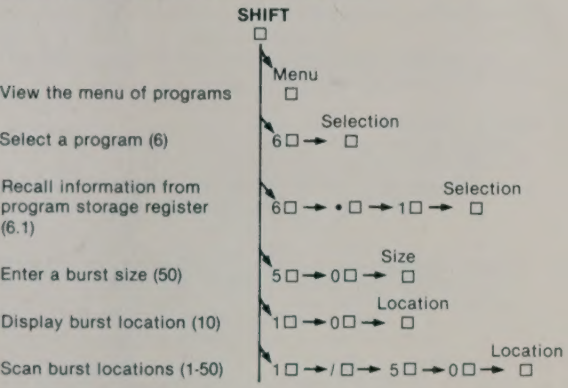
FRONT PANEL CONTROLS		
Group	**Name**	**Function**
Trigger	Ext/Auto	Toggle Action— LED ON: External trigger mode on (trigger from IEEE bus, manual, or if armed the rear BNC). LED OFF: (Internal) Automatic trigger mode.
	ARM BNC	Toggle Action— LED ON: BNC rear in put trigger armed, will initiate trigger if appropriate level transition or switch closure occurs on BNC. LED OFF: BNC rear input disarmed.
	Manual	Shift LED OFF, ext/auto LED ON, DMM will take readings per burst size setting. In red shift LED ON, triggers one reading, but does not store in burst location.
Control	Local	Puts the 8520A local (unless in local lockout mode).
	Remote	LED is ON if instrument on IEEE bus under remote control. LED if OFF if in local. (Note: Cannot re-enter remote from front panel.)
	Miscellaneous Controls	
	Shift	Toggle Action— LED ON: Dual function keys on second level operation. LED OFF: DMM mode.
	Status/Menu	With shift LED OFF, displays the current Status (function, range, reading rate and filter settling time) of the 8520A.
	Status/Menu	Shift LED ON, displays the Menu of available programs.



FRONT PANEL CONTROLS	
Miscellaneous Controls	**Function**
Reset	Single Push: Clears *all* program data accumulation registers, retains all programmed constants, exits to DMM mode. Double Push: When pressed in quick succession clears program data registers, retains programmed constants, selects 100 Vdc range, 2 reading/sec, 500 msec filter settling time, internal trigger, exits to DMM mode.
Programs IN USE/OFF	Toggle Action— LED ON: Turns on selected math programs. LED OFF: Turns off selected math programs.
CE (Clear Entry)	Shift LED off, no effect. Shift LED on, clears last entry/numeric.
Input	Key depressed for connection via rear connector block. Key out for normal front panel connections.
Guard	Key depressed for external guard. Key out for guard tied to source and input low. Note: In normal two wire operation this switch is always out.

FRONT PANEL CONTROLS		
Group	**Name**	**Function**
SPECIAL CONTROLS		
Burst	Size	Shift LED OFF, displays current burst size setting selected, default = 1. Shift LED ON, sets burst size to number entered on numerics, n where $-999 \leq n \leq 999$. Exits to DMM mode with shift LED off.
	Location	Shift LED OFF, key has no effect. Shift LED ON, when depressed will cause 8520A to display data stored in selected location. Each key depression will step to the next burst location. Can be used in conjunction with numerics to select a particular location; Shift, n, Location or used to scan through a particular segment of memory. Shift, n, /, m, Location
Program	Selection	Shift LED OFF, when depressed will cause 8520A to display current program(s) selected. Shift LED ON, when used in conjunction with numerics allows the selection of up to 3 programs at a time for use. Shift.a,b,c.selection Note: Programs 0 & 1 may not be stacked, in addition only one of programs 11, 12, 13, 14 may be selected while stacking programs.
Program	Data	Shift LED OFF, key has no effect. Shift LED ON, key is used to enter data as a program constant. Prompts help user determine the destination of the data. After entry by pressing data the 8520A either advances to the next prompt or exits to DMM mode.

The real key to the power of the 8520A, the shift key, accesses math programs, burst operation, numeric key functions and a menu of the instrument's available programs.

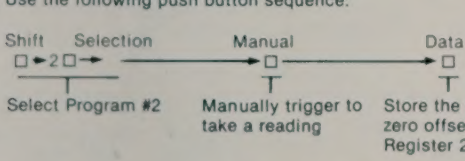


PROGRAM EXAMPLES

Program #2 (Zero)

In the ohms function the Zero program can be used to eliminate the effects of test lead resistance which will hamper low ohm measurements.

1. Enter the desired ohms range or auto range and short the test leads.
2. Use the following push button sequence:

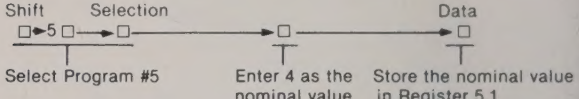


3. Toggle on the programs in use button. The stored reading is now subtracted from subsequent measurements.

Program #5 (△PCT)

The delta percent program is used to measure the deviation (in %) of the input with respect to a nominal value entered by the operator from the keyboard, an external source or from a burst memory location.

1. Use the following push button sequence to select the program and enter 4 (volts) as the nominal value:

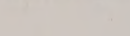


2. Toggle on the programs in use button. Subsequent measurement will be converted to and displayed in percent deviation (△PCT) from the stored nominal value.

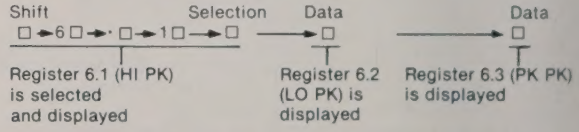
Program #6 (Peak)

The peak program when in use continually stores and updates the high and low peak of the applied input. These values are stored in registers 6.1 and 6.2.

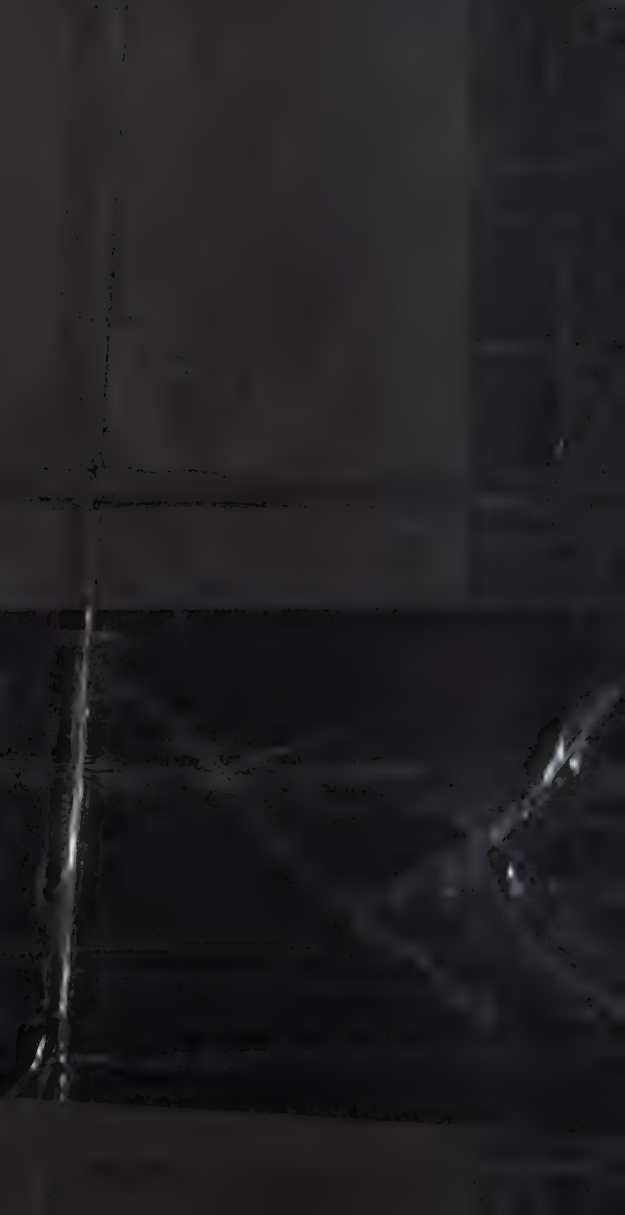
1. Use the following push button sequence to select the peak storage program:



2. Toggle on the "Programs In Use" pushbutton to begin storing the high and low peaks.
3. To recall the high and low peaks monitored during program operation, use this sequence:



4. To clear the program storage registers and begin accumulating new data, push the "Reset" button once.



Note In the following program descriptions

S = is the input signal for the program in use.

X = the value passed to the next stacked program.

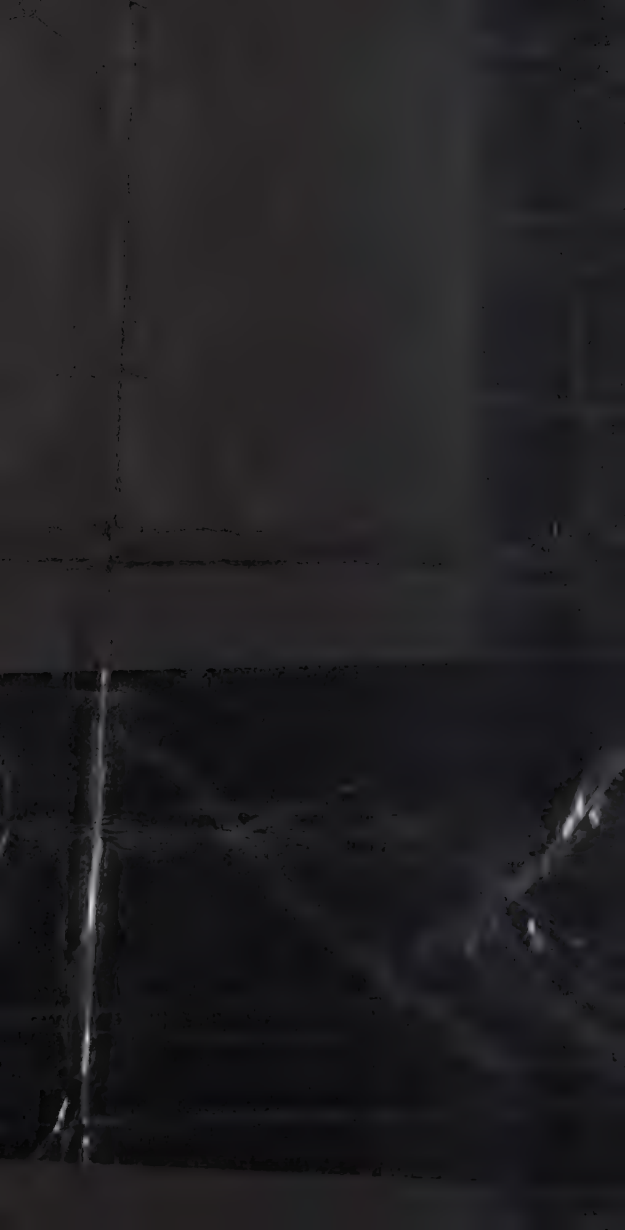
• = a programmable constant can be entered in this register if desired.

PROGRAM DESCRIPTIONS			
Program Or Reg. Number	**Name Displayed**	**Description/ Equations**	**Power On Value**
r0 1	DOPT	Display Option Register— Allows the operator to display any accumulation register of the program currently in use. NOTE: After selecting a program, *select* r0.1, and enter the program register number as *Data.*	
P1	Test	Program to run 4 diagnostic tests on the 8520A.	
	Test 1	Analog Tests— 16 tests with set limits, program executes on each test on a Pass (PS) Fail (FL) basis. NOTE: For local operation, if any test fails program execution halts, but can be continued by depressing the DATA key.	
	Test 2	Digital Tests— 3 digital tests which execute on a Pass/Fail basis. 1) ROM checksum test Fail display = Err 14 ROM 2) RAM read/write test Fail display = Err 15 RAM 3) Guard crossing circuit test Fail display = Err 17 HDWR If all tests pass, PASS DGTL is displayed.	

Program Or Reg. Number	Name Displayed	Description/ Equations	Power On Value
	Test 3	Keyswitch & LED Tests— Each key lights two corresponding LED segments. (SEE CHART IN INSTRUCTION MANUAL) Reset key initiates LED test which exercises all LED's in sequence. Shift key allows exit from Test 3 at any time.	
	Test 4	Trouble Shooting Test— Used to trouble-shoot digital circuitry, sends a 40 (hex) across the guard crossing. Exit test by pushing any key.	
P2	ZERO	Zero— Used to apply either a VDC or OHM offset to measurement.	
r2.0		Display Register— X = r2.0 = S-r2.n where n = 1 or n = 2	
*r2.1	DZRO	DC Zero Register- Programmable constant for off-setting DC level.	0
*r2.2	OZRO	OHM Zero Register Programmable constant for zeroing lead resistance	0
P3	XREF	External Reference: Makes a measurement and compares reading to external reference.	

Program Or Reg Number	Name Displayed	Description/ Equations	Power On Value
r3.0	XREF	External Reference Register X = r3.0 = S/r3.1	0
r3.1	VSRF	External Reference Voltage— r3.1 = r3.2 – r3.3 If r3.1 < .5V, "urVXRF" is displayed and the short status is set to 09 indicating an underrange condition exists.	1
r3.2	XRFH	External Reference High— r3.2 is voltage measured at the EXT REF HI terminal.	1
r3.3	XRFL	External Reference Low— r3.3 is voltage measured at the EXT REF LO terminal. NOTE: If a voltage > 16.5V is present on either EXT REF LO or HI "or VXRF" is display on the front panel and the short status is set to 08, indicating an over range on the External Reference Input exists.	0
P4	OSR	Offset, Scale and Ratio Provides a method for scaling the input signal to user's expectations.	
r4.0		OSR Display Register— $X = r4.0 = \frac{(S \cdot r4.1) \times r4.2}{r4.3}$	0
*r4.1	OFST	Offset— Programmable constant value to be subtracted.	0
*r4.2	SCAL	Scale— Programmable Multiplication Constant.	1
*r4.3	RATO	Ratio— Programmable Division Constant.	1

Program Or Reg. Number	Name Displayed	Description/ Equations	Power On Value
P5	ΔPCT	Percent Deviation- Computes percent deviation from programmed nominal value.	
r5.0	ΔPCT	Percent Deviation Ouput Register $X = r5.0 = (S - r5.1) \times 100/r5.1$	0
*r5.1	NOM	Nominal Value— Programmable constant entered by user.	1
P6	PEAK	Peaks— Program to determine Hi Peak, Low Peak, and Peak to Peak value of an input signal.	
r6.0		Reading— $X = r6.0 = S$	0
r6.1	HIPK	High Peak (Upper Peak)— When displayed will represent the highest excursion of the input signal. Initially set at very low value. $r6.1 = \max(S)$	-10^{18}
r6.2	LOPK	Lower Peak— When displayed represents lowest excursion of input signal $r6.2 = \min(S)$	$+10^{18}$
r6.3	PKPK	Peak to Peak— Display peak to peak excursion of input signal $r6.3 = r6.1 - r6.2$	0
P7	LIM	Limits— Program which tests reading against operator programmable limits, displays HIGH, PASS, or LOW	
r7.0		Limits Output Register— $X = S$ r7.0 = HIGH, PASS or LOW on display. r7.0 = + 2, + 1, − 1 over IEEE bus.	PASS



Program Or Reg. Number	Name Displayed	Description/ Equations	Pow On Valu
*r7.1	ULMT	Upper Limit— Programmable constant selected by user.	0
*r7.2	LLMT	Lower Limit— Programmable constant selected by user.	0
r7.3	NHI	Number of HIGH Readings—	0
r7.4	NLO	Number of LOW Readings—	0
r7.5	NPAS	Number of Pass Readings—	0
r7.6	NTTL	Number of Total Readings—	0
P8	STAT	Statistics— Program computes statistical data including mean, variance and standard deviation of all readings taken since the registers were reset.	
r8.0		Statistics Output Register— $X = r8.0 = S$	0
r8.1	NUM	Number of Readings— $r8.1 = n;\ n < 2^{23}$.	0
r8.2	AVE	Average of Readings— $r8.2 = \text{sum } (S)/n$	0
r8.3	STDV	Standard Deviation of Readings— $r8.3 = r8.4$	0
r8.4	VAR	Variance of Readings— $r8.4 = \text{sum } (S - b)^2 - \text{sum } (S/b)^2/n/n1$	0
r8.5	SUM	Sum of Readings— $r8.5 = \text{sum } (S)$	0
r8.6	SMSQ	Sum of Squares of Readings— $r8.6 = \text{sum } (S - b)^2$	0
r8.7	BIAS	Bias = first reading For improved computation of r8.3 and r8.4 $r8.7 = b$ (= first reading)	0

Program Or Reg. Number	Name Displayed	Description/ Equations	Power On Value
r8.8	DIF	Difference, Last Reading—Bias r8.8 = S-b	0
r8.9	SDIF	Sum of Differences r8.9 = sum (S-b)	0
P9	LFAC	Low Frequency AC Program computes the running RMS Value of the digitized signal. Instrument must be set to following state preceeding a measurement: • VDC • Fixed Range • Reading Rate = 5 times Input Frequency • 5msec Filter	
r9.0	LFAC	Low Frequency RMS Volts Output Register (filtered)— x = r9.0 = (r9.4)/32	0
r9.1	NUM	Number of readings, n r9.1 = n	0
r9.2	SMSQ	Sum of the Squares r9.2 = r9.2 + $(S)^2$	0
r9.3	ACLF	Unfiltered LFAC RMS Value r9.3 = r9.2/9.1	0
r9.4	RSUM	Filter Summing Register— The 32 values of ACLF are summed here r9.4 = sum (r9.3) NOTE: After every 32 readings this registers is reset to zero.	0
P10	dB	The dB Program computes dB, dBm or dBv with proper constants stored in various registers.	
r10.0	dB	dB Output Register— X = r10.0 = 20 log (S/r10.1) + 10 log (r10.2)/[(r10.3)(r10.4)] Registers 10.1 thru 10.4 are set by user according to dB ratio desired using the following equations:	

Program Or Reg. Number	Name Displayed	Description/ Equations	Power On Value
		A) dBV = 20 log (V/Vref)	
*r10.1	Vr	Voltage Reference, Vref r10.1 = Vr = Vreference	1.0
*r10.2	Ri	Input Resistance r10.2 = Ri = 1.0	1.0
*r10.3	RL	Load Resistance r10.3 = RL = 1.0	1.0
*r10.4	Pr	Power Reference r10.4 = Pr = 1.0	1.0
		B) dB or dBM = 10 log [(V^2/Rload)/Pref]	
*r10.1	Vr	Voltage Reference, Vref r10.1 = Vr = 1.0	1.0
*r10.2	Ri	Input Resistance r10.2 = Ri = 1.0	1.0
*r10.3	RL	Load Resistance r10.3 = RL = RLoad	1.0
*r10.4	Pr	Power Reference r10.4 = Pr = 1.0	1.0
		C) dB = 10 log [(V^2/$Vref^2$)(Ri/RL)]	1.0
*r10.1	Vr	Voltage Reference r10.1 = Vr = Vreference	1.0
*r10.2	Ri	Input Resistance r10.2 = Ri = R input	1.0
*r10.3	RL	Load Resistance r10.3 = RL = Rload	1.0
*r10.4	Pr	Power Reference r10.4 = Pr = 1.0 * Power on Sets R (10.1, 10.2, 10.3, 10.4) = 1.0	1.0

Program Or Reg. Number	Name Displayed	Description/ Equations	Power On Value
P11	RTD	Resistance Temperature Detector Program: Program implements equations which convert the resistance of an RTD to temperature in °C; °F and K are also available. NOTE: The DMM should be in 4 wire Ω and the 1000 range.	
r11.0	°C	RTD degrees C output x = r11.0	0
r11.1	K	Calculated Kelvin r11.1 = r11.0 + 273.15	0
r11.2	°F	Calculated Degrees Farenheit r11.2 = (9/5)r11.0 + 32	0
*r113	R0	Resistance of probe at 0 °C	100
*r11.4	ALPH	Alpha—slope of resistance curve from 0 to 100 °C/RO	.00385
*r11.5	DELT	Delta—High temperature RTD Parameter	1.45
*r.11.6	BETA	Beta—Low temperature RTD Parameter	.11
P12	JVC	Junction Voltage Celcius Program Supports the use of the Fluke 80T150 C Temperature Probe which outputs a voltage in the millivolt range proportional to the temperature in degrees Celsius. °F and K may also be displayed.	
r12.0	°C	Degrees Celcius Output Register X = r12.0 = 1000 (S)	0
r12.1	K	Kelvin Output Register r12.1 = r12.0 + 273.15	0
r12.2	°F	Degrees Farenheit Ouput Register r12.1 = (9/5) r12.0 + 32	0

Program Or Reg. Number	Name Displayed	Description/ Equations	Pow On Val
P13	JVF	Junction Voltage Farenheit Program supports the use of the Fluke 80T-150 F Temperature Probe which outputs a voltage in millivolts proportional to the temperature in degrees Farenheit. °C and K may also be displayed.	
r13.0	°F	Degrees Farenheit Output Register x = r13.0 = 1000 (S)	0
r13.1	°C	Degrees Celsius Output Register r13.1 = (5/9)r (13.0 – 32)	0
r13.2	K	Kelvin Output Register r13.2 = r13.1 + 273.15	0
P14	THMS	Thermistor Linearization Program—This program converts the resistance of a thermistor to temperature. Output registers are available for °C, °F, K.	
r14.0	°C	Thermistor Output Register for °C X = r14.0	0
r14 1	K	Thermistor Output Register for K.	0
r14 2	°F	Thermistor Output Register for °F	0
		The paramaters A0, A1, A2, A3 describe the resistance temperature characteristics of the thermistor. The default settings given below may be changed to match the thermistor being used. The assumed form of the R-T characteristic is: $1/T = A_0 + A1\ (lnR) + A_2(lnR)^2 + A_3(lnR)^3$	
*r14 3	A0	Parameter A0	1.282015E-
*r14 4	A1	Parameter A1	2.372517E-
*r14 5	A2	Parameter A2	-1.162073E
*r14 6	A3	Parameter A3	9.682669E-0

Program #	Name	Display Prompt	Reg. #	"Data" To Be Entered
1	TEST	"?" Test		Test Number Desired (i.e. 1, 2, 3, or 4)
2	ZERO	+ .00000 DZRO	(2.1)	Offset Value for DC Zero
(If in OHMS)		+ .00000 0ZRO	(2.2)	Offset Value for Ohms Zero
4	OSR	+ .00000 OFST	(4.1)	Offset Constant
		+ 1.00000 SCAL	(4.2)	Scaling Constant
		+ 1.00000 RATO	(4.3)	Ratio Constant
5	ΔPCT	+ 1.00000 NOM	(5.1)	Nominal Value
7	LIM	+ .00000 ULMT	(7.1)	Upper Limit Value
		+ .00000 LLMT	(7.2)	Lower Limit Value
10	dB	+ 1.00000 Vr	(10.1)	Voltage Reference
		+ 1.00000 Ri	(10.2)	Input Resistance
		+ 1.00000 R1	(10.3)	Load Resistance
		+ 1.00000 Pr	(10.4)	Power Reference
11	RTD	+ 100.000 RO	(11.3)	Resistance at 0°
		ALPH – + 3.850 E-03	(11.4)	Parameter Alpha
		DELT – + 1.45000 DELT	(11.5)	Parameter Delta
		BETA – + 100.000 E-03	(11.6)	Parameter Beta
	NOTE:	These are default values for the most common RTD probes including the Fluke Y2025. The operator may alter these values if they do not accurately describe the probe he wishes to use.		
14	THMS	(A0) + 1.28201 E-03	(14.3)	Parameter (A0)
		(A1) + .23725 E-03	(14.4)	Parameter (A1)
		(A2) – 116.207 E-09	(14.5)	Parameter (A2)
		(A3) + 96.827 E-09	(14.6)	Parameter (A3)
	NOTE:	These are default values which match nominal characteristics of the YSI 44007, FENWALL UUA35JI, OMEGA UUA35J3 or equivalent. The operator may alter these values to match the thermister he wishes to use.		

RESPONSES

Error Codes

Error	Name	Explanation
00		No errors
01	HV	High voltage present on an ohms measurement
02		SYNTAX ERROR
03	NOVR	Overflow of registers or numeric overflow
03	RTD	The RTD math program failed to converge
04	KEY	Invalid keystroke
05	FLTR	Async. reading rate, filter cannot be changed
06	ZERO	Can't use P2 (zero) with VAC or VA + D
07	IEEE	IEEE input buffer overflow
08	or VXRF	External reference overrange
09	ur VXRF	External reference underrange
10	+ HHH.HH VDC	Normal input overrange
11	HDWR	8048 didn't properly echo a command
12	rrtoo FAST	Reading rate too fast for current math & filter
14	ROM	ROM checksum error
15	RAM	RAM test failed
16	LINE	Could not determine line frequency of power up
17	HDWR	Could not synchronize with 8048
18	OPEn INPT	Input not open during analog test program (PI)
22	HDWR	Error while measuring volts for ohms change
23	HDWR	Time out error, 8048 didn't respond as expected
24	HDWR	Resynchronization error
25	HDWR	Ohms reference error
30	UART	Guard crossing uart timeout
31	UART	Parity
32	UART	Overrun
33	UART	Overrun + parity
34	UART	Framing
35	UART	Framing + parity
36	UART	Framing + overrun
37	UART	Framing + overrun + parity
A1	GARD	8048 interrupt error
A3	GARD	8048 analog interrupt error
A5	GARD	8048 uart error
A7	GARD	8048 command error

BURST OPERATION

Concepts

NOTE: For simplicity this will be written to describe operation with option – 010 installed (400 memory locations).

1. The last 400 readings are always being stored even if no burst size has been set (Burst size = 1).
2. When the burst size = 1, memory locations are filled with data in logical order 1, – 1, – 2, – 3, – 4,... – 399, with the most recent reading stored in location #1 and the oldest reading in location – 399.
3. The memory is circular in structure (i.e., location #1 is adjacent to #400), see figure 1, which allows new data to be written over (replace) previously stored data. The largest valid burst size is 999 which adds two interesting sub-concepts:

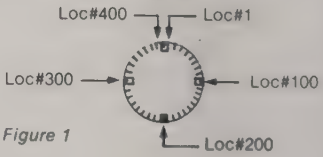
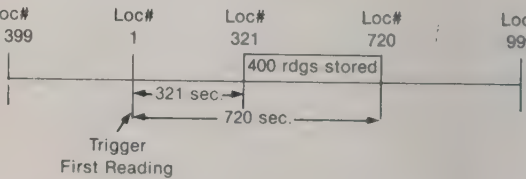


Figure 1

a) The time frame associated with a burst of readings can be delayed by a time factor equal to the burst size × the reading rate. See figure 2 below:



Burst size = 720
Reading rate = 1 rdg/sec.

720 × 1 = 720 sec. = 12 min.

Figure 2

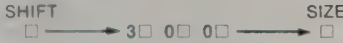
b) Due to the wrap around caused when the burst size exceeds 400, each memory cell has more than one address. That is locations 1, 401, and 801 address the same memory cell.

BURST OPERATION

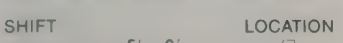
Push Button Examples

NOTE: By selecting external trigger a starting point is established. When ready to to take data a push of the manual trigger button initiates the burst. When the burst size is reached, triggering will stop.

1. Set a burst size of 300.

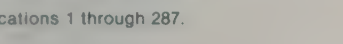


2. Recall location 50 and display the data stored in this location.



To increment through the locations in a forward direction (i.e., 51, 52, 53, etc.) push the location button repeatedly; to reverse the direction, push the change sign (+ / –) button. Now pushing the location button will cause the locations to be displayed in descending order (53, 52, 51, etc.).

3. Scan locations 1 through 287.



The scan rate is determined by the selected reading rate. To stop the scan push the location button. The memory can be scanned in reverse order by entering the larger number first.

NOTE Readings stored in burst memory can be subjected to and/or modified by math programs by selecting up to three programs simultaneously, activating the "programs in use" button, and recalling the readings as described above. The unmodified readings are still available in their original locations.

CORRELATION CHART

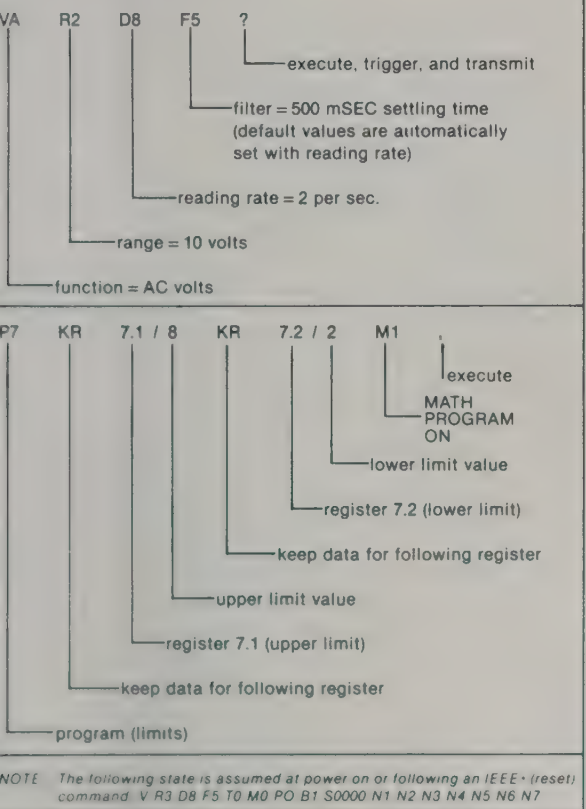
Burst/Trigger/Readings

Burst Size	Ext/Auto	Arm BNC	BNC Trigger	Manual	Internal	Last Reading Location	Previous Readings	
+1	Auto	Off			X	1	-1,-2,-3,...	1 reading per trigger does not stop
+1	Ext	On	X			1	-1,-2,-3,...	1 reading per BNC trigger does not disarm
+N	Auto	Off			X	N	N-1,N-2,...	1 reading per trigger does not stop
+N	Ext	Off		X		N	N-1,N-2,...	Starts after manual trigger takes n readings and stops
+N	Ext	On	X			N	N-1,N-2,...	Starts after BNC trigger takes N readings, disarms & stops
-N	Auto	Off			X	|N|*	|N|-1,|N|-2,...	1 reading per trigger does not terminate
-N	Ext	Off		X		|N|*	|N|-1,|N|-2,...	1 reading per manual trigger does not terminate
-N	Ext	On	X			|N|*	|N|-1,|N|-2,...	1 reading per BNC trigger disarms after N triggers

*|N| — Denotes absolute value of N

PROGRAMMING FORMAT

Typical Command Strings



NOTE The following state is assumed at power on or following an IEEE • (reset) command V R3 D8 F5 T0 M0 P0 B1 S0000 N1 N2 N3 N4 N5 N6 N7

IEEE COMMAND CHARACTERS	
Code	**Function Commands**
V	DC Volts.
VA	AC Volts.
VC	AC + DC Volts.
Z2	2 Terminal Ohms.
Z3	Nanosiemens.
Z4	4 Terminal Ohms.
	RANGE COMMANDS
R0	100 mVDC; 100Ω; AUTO VAC, VA + D.
R1	1 volt; 1000Ω.
R2	10 volts; 10000Ω.
R3	100 volts; 10KΩ.
R4	650 VAC/VA + D 1000 VDC 100KΩ 100nS
R5	Auto volts; 1MΩ.
R6	Auto volts; 10MΩ.
R7	Autorange.
R8	Exit autorange. Remains in present range.

READING RATE COMMANDS					
	CODE	LINE FREQUENCIES 400 Hz	60Hz	50Hz	DEFAULT FILTER CODE
		READINGS PER SECOND			
DC & *LOW OHMS	DO (ASYNC)	—	200	—	FO
	D1	228	240	200	FO
	D2	114	120	100	FO
	D3	57	60	50	F1
	D4	38	40	40	F1
	D5	19	20	20	F2
	D6	9.5	10	10	F3
ALL FUNCTIONS & RANGES	D7	4.8	5	5	F4
	D8	1.9	2	2	F5
	D9	1.0	1	1	F6
		READINGS PER MIN.			
	D10	30	30	30	F6
	D11	12	12	12	F6
	D12	6	6	6	F6
	D13	2	2	2	F6
	D14	1	1	1	F6
		READINGS PER HOUR			
	D15	30	30	30	F6
	D16	12	12	12	F6
	D17	6	6	6	F6
	D18	2	2	2	F6
	D19	1	1	1	F6

*Low Ohms = 10Ω – 10kΩ
Hi Ohms = 100kΩ – 10MΩ

FILTER			
VDC and Low Ohms*	**Sample/ Reading**	**DC Filter**	**Front Panel Dspy**
F0	1	Fast	5 msec
F1	4	Fast	25 msec
F2	8	Fast	50 msec
F3	16	Fast	100 msec
F4	16	Slow	200 msec
F5	64	Slow	500 msec
F6	128	Slow	1000 msec
VAC and VA + D	**Sample/ Reading**	**DC/AC Filter**	**Front Panel Dspy.**
F3	16	F/F	100 msec
F4	16	S/F	200 msec
F5	64	S/S	500 msec
F6	128	S/S	1000 msec
Hi Ohm* and Nanosiemens	**Sample/ Reading**	**DC Filter**	**Frnt Panel Dspy.**
F5	16	Fast	Fast
F6	128	Slow	Slow

*Low Ohms = 10Ω – 10kΩ, Hi Ohms = 100kΩ – 10MΩ

CODE	TRIGGER
T0	Internal (Auto) Trigger Mode
T1	External Trigger Mode
	PROGRAMS
P1	Test*
P2	Zero
P3	External Reference
P4	Offset, Scale, Ratio
P5	Percent Deviation
P6	Peak Values
P7	Limits
	Option -010 Additional Programs
P8	Statistics
P9	LF RMS Volts
P10	DB Ratio
P11	RTD Temperature Conversion*
P12	80T-150C Probe Conversion*
P13	80T-150F Probe Conversion*
P14	Thermistor Linearization*
	Note: Example - P456 selects 4, 5, and 6. Up to 3 programs may be stacked.
	*May not be stacked, programs P11, P12, P13, P14 should not be stacked with each other.

CODE	Programs IN USE/OFF
MO	Programs off
M1	Selected Programs On
	MEMORY AND STATUS COMMANDS
GM<I>	Transmit (Get) Memory Location <Integer>
GR<RegNum>	Transmit (Get) Register <Register Number>
GS	Transmit (Get) Short Form Status
GF	Transmit (Get) Full Status
KEs	Keep "s" as error response
KVs	Keep "s" as overrange response
B<I>	Set Burstsize = <Integer>
KR<RegNum> /<Value>	Set Register = <Register Number> set to <Value>
W<I1>/<I2>	Transmit (Get) Memory From <Integer 1> to <Integer 2>
Y<I1>/<I2>	Scan from <Integer 1> to <Integer 2>
NOTES:	GS—format for short form status message is <d1 d2><CR><LF>, where <d1 d2> is a 2 digit error code.
	GF—transmits full status ("n" characters in programming format) <function><range>...<misc>...<CR><LF>
	SPECIAL CONTROLS
	Immediate Characters
*	Reset—to Default State
%	Halt—Stop execution of current activity and look at command buffer
&	Clear Serial Poll "request for service" bit
	Termination Characters
;	Execute previous command string
?	Execute, trigger, and transmit reading
!	Execute, arm trigger, and transmit reading

CODE	MISCELLANEOUS CONTROL
I1	Front Panel—I1 Inhibit (Disable) Front Panel
N1	N1 Enable Front Panel Dspy.
I2	Filter Timeout—I2 Inhibit
N2	N2 Enable
I3	Linefeed—I3 Inhibit Line Feed
N3	N3 Enable (Send) Linefeed
I4	Transfer—I4 Transfer Binary
N4	N4 Transfer ASCII
I5	Speed—I5 High Speed Mode (2 Byte Fixed Binary)
N5	N5 Normal DMM Mode (4 Byte Floating Point Binary, or ASCII)
I6	EOI—I6 Inhibit EOI
N6	N6 Enable EOI
I7	Remote Reading Transfer—I7 Unlock Reading Transfer
N7	N7 Lock Reading Transfer
	IEEE TRIGGER COMMANDS
	Group Execute Trigger—GET A GET from the controller will trigger a reading any time. When the 8520A receives a GET, it goes into external trigger mode ("T1"). Note: GETs sent too fast for the 8520A to process are ignored.

CODE	IEEE SERIAL POLL
S<ijkm>	Serial Poll Enable Option
<0000>	SRQ Disabled
<0001>	Output Ready, Overrange, Error
<0002>	Overrange
<0004>	Error
<0010>	End of Burst
<0020>	New High Peak
<0040>	New Low Peak
<0100>	Reading High
<0200>	Reading Pass
<0400>	Reading Low
<1000>	LFAC Filtered Output Ready
<2000>	Undefined
<4000>	Undefined
	Acceptable Forms
	Sm, Skm, Sjkm, Sijkm S1 = S01 = S001 = S0001
	Add Options for Multiple SRQ's Example: S11 – Output Ready, End of Burst
	Responses to Serial Poll During APRS (Affirmative Poll Response State), the Bus has the following byte with bits defined as follows:

BIT	8	7	6	5	4	3	2	1
	0	rsv	error	0	See Below	End of Burst	Over-Range	Output Ready

BIT 7—rsv indicates whether the 8520A requires service (rsv = 1) or doesn't require service (rsv = 0).

BIT 4—logical OR, of the following SRQs New High Peak, New Low Peak, Reading High, Reading Pass, Reading Low, LFAC Ready.

DATA BUS FORMATS

ASCII Floating Point

Readings, results of math on reading, and registers.

Range	Format	Maximum Value
100mV	+199.999	E–3
1V	+1.99999	E+00
10V or 10Ω	+19.9999	E+00
100V or 100Ω	+199.999	E+00
1000V or 1000Ω	+1999.99	E+00
10kΩ	+19.9999	E+03
100kΩ	+199.999	E+03
1MΩ	+1.99999	E+6
10MΩ	+019.999	E+6
100nS	+0199.99	E–9

Note: Sent over bus with <CR> and an optional <LF> (N3/I3)

Binary Floating Point

Readings, results of math on readings, and registers.

Byte 1	Byte 2	Byte 3	Byte 4
EEEEEEEE	S.MMMMMMM	MMMMMMMM	MMMMMMMM

↑ implied binary point

E = 2's complement exponent
M = signed magnitude mantissa
S = sign of mantissa (1 = negative)

High Speed Mode

High speed readings in 2 byte binary.

Byte 2	Byte 1
SFFFF.FFF	FFFFFFFE

↑ implied binary point

S = 2's complement sign
F = 2's complement number
E = 1 if an error condition exists
E = 0 if no error exists

Special Cases

Display option register
m.n <CR> <LF>
m = math program number
n = the register number

P7 "Limits" format
+2 <CR> <LF> High
+1 <CR> <LF> Pass
–1 <CR> <LF> Low

REAR PANEL SWITCHES

IEEE Selection Switches

Address	Binary codes from 0 thru 30. (Up = 1, down = 0)
Trigger	When set to 1, trigger occurs on rising edge; when set to 0, trigger on falling edge.
Talk Only	When set to 1, 8520A operates in talk only mode; 0, 8520A operates as a Talker/Listener.
Shield	When set to 1, 8520A IEEE cable shield tied to ground; 0, 8520A IEEE cable shield floating.

POWER ON OR DOUBLE RESET STATUS

A power up or double push of the reset selects the following states:

Function	= VDC
Range	= 100
Reading Rate	= 2rdgs/sec
Filter	= 500 msec
Trigger	= Auto

Note: A double reset does not change the programmable constants in registers. The double reset does reset accumulating registers to default values.

Power on resets all registers to defaults as listed below.

V R3 D8 F5 T0 M0 P0 B1

N1 N2 N3 N4 N5 N6 N7 S0000

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John Fluke Mfg. Co., Inc.
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